

CARDIOLOGY NOTEBOOK

*For preliminary instruction
in medical curricula*

COLUMBIA UNIVERSITY
COLLEGE OF
PHYSICIANS AND SURGEONS



GRUNE & STRATTON

NEW YORK AND LONDON

Sections

- 1 CARDIAC FLUOROSCOPY AND X RAY 6-34
 - 2 ELECTROCARDIOGRAPHY 35-81
 - 3 HEMODYNAMICS 82-93
 - 4 NOMENCLATURE FOR CARDIAC DIAGNOSIS 94-95
- INDEX 96

NOTE. A detailed list of contents is given on the first page of each of the four sections.

Foreword

DURING THE PERIOD OF TRANSITION from the basic sciences to clinical medicine the medical student needs some immediate orientation in many aspects of clinical medicine at a time when he lacks an adequate grasp of any single subject.

This Notebook is designed to make readily available to him in the simplest form a few basic examples of the method and language of cardiology and thereby to make easier and clearer the initial clinical instruction in this subject. The subject matter has been divided into four sections (1) cardiac fluoroscopy and x ray (2) electrocardiography (3) hemodynamics (4) nomenclature for cardiac diagnosis.

The idea of the Notebook originated in the course of discussions in a Cardiovascular Teaching Committee which had been formed to develop improvements in the teaching of cardiology at the College of Physicians and Surgeons, under a grant from the National Heart Institute. Much additional assistance has been given by the Institute as the preparation of the Notebook has progressed. The editors take pleasure in acknowledging this and wish particularly to thank Dr J Franklin Yeager, Chief of the Grants and Training Branch of the National Heart Institute for his interest, encouragement, and helpful counsel during the course of the work.

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April 1955

Acknowledgments

THE ILLUSTRATIONS FOR THIS NOTEBOOK are based except where indicated upon studies performed in the Departments of Medicine and Radiology of the Presbyterian Hospital, and the Cardiopulmonary Laboratory of Bellevue Hospital. The heart models in Section I are those of the American Heart Association. The additional illustrations were derived from the following sources:

Figures 1-3-5 (and accompanying text) Modified after Grossman V. Compendium of Cardiac Roentgenology. Teaching and Research Council, Michael Reese Hospital, Chicago, Illinois, 1945.

Figure 13. Dotter C. T. and Steinberg I. Angiocardiographic interpretation. *Radiology* 53: 515, 1949.

Figure 14. Redrawn after Taussig H. Congenital Malformations of the Heart. Commonwealth Fund, New York, 1947.

Figure 15B. Modified after Coblenz B., Harvey R. M., Ferrer M. I., Courmand A., and Richards D. W. Jr. The relationship between electrical and mechanical event in the cardiac cycle of man. *Brit. Heart J.*, 11: 1, 1949.

Figure 16-1. Hoff H. E. in Fulton, J. F. A Textbook of Physiology. W. B. Saunders Co., Philadelphia, 1949.

Figure 16C and 16D. Braunwald, E., Moscovitz, H. L., Amram, S. S., Lasser R. P., Sapin S. O., Hummelstein A., Ravitch M. M., and Gordon A. J. The hemodynamics of the left and of the right of the heart as studied by simultaneous left atrial, left ventricular, and aortic pressures: particular reference to mitral stenosis. *Circulation* in press.

Figure 17. The cardiac catheterization group, Mt. Sinai Hospital, New York.

Figure 18. Grishman A. and Donoso E. Mt. Sinai Hospital, New York.

The nomenclature for cardiac diagnosis is based largely on "Nomenclature and Criteria for Diagnosis of Diseases of the Heart and Blood Vessels," 5th Edition, New York Heart Association, Inc., New York, 1953.

Introduction

THE BASIS of all cardiac diagnosis and treatment is an adequate history and physical examination. The great majority of clinical problems can be handled by these two procedures alone.

These methods can only be gained at the bedside and no plethora of laboratory examinations can replace them. Indeed laboratory studies lack direction and are often of little avail in the absence of adequate prior clinical evaluation.

The subsequent pages are designed to supplement rather than substitute for such clinical evaluation.

Cardiac Fluoroscopy and X Ray

SECTION 1

General Comments	7
STANDARD POSITIONS for Fluoroscopy and X-Ray	
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It is important for the student to be instructed in the technique of fluoroscopic examination. This instruction should include proper handling of the apparatus so as to minimize radiation hazard to himself and the patient. It is worthy of emphasis that adequate visual accommodation prior to fluoroscopy will not only improve the ability to discern fine detail such as intracardiac calcifications but will also shorten the time required for complete fluoroscopic examination.

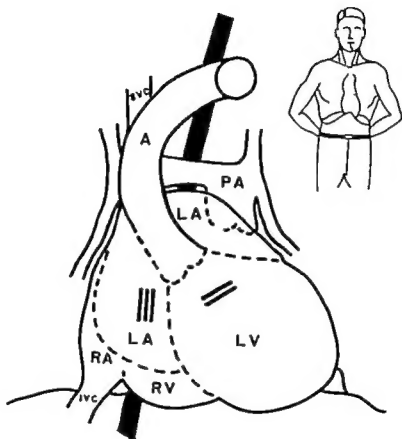
As in the physical examination information gained from extra-cardiac regions may direct the examination to the correct cardiac disorder. It is therefore essential that the neck, lung, diaphragm and thoracic cage be evaluated prior to focussing on the heart.

It is no longer adequate in most instances to describe the heart merely as enlarged. It is usually possible by taking advantage of the proximity of the cardiac chambers to the esophagus, trachea and spine and by examination of the patient in various positions to delineate the size and shape of individual cardiac chambers and vessels.

The standard positions for cardiac fluoroscopy are

1. Postero-Anterior (PA) patient facing the screen
2. Left Anterior Oblique (LAO) patient's left shoulder turned toward the screen with patient facing the screen
3. Right Anterior Oblique (RAO) patient's right shoulder turned toward the screen with patient facing the screen

These positions are illustrated in the figures on pages 8, 12, 16. The degree of obliquity necessary for adequate visualization varies with the habitus of the patient but is more marked in the LAO than in the RAO.



THE POSTERO-ANTERIOR (PA) VIEW

FIGURE 1—AT LEFT

The outline of the cardiac shadow can be divided into segments formed by individual chambers or great vessels

On the patient's right the upper curve of the RIGHT ATRIUM is separated from the ASCENDING AORTA by an indentation. The difference between atrial and aortic pulsations further delineates the position of each structure on the contour of the right border of the heart

On the left three curves are noted from below upwards: the lateral curve of the LEFT VENTRICLE, the PULMONARY ARTERY and the ARCH OF THE AORTA. Occasionally the tip of the LEFT AURICULAR APPENDAGE may be identified above the left ventricle usually at about the third interspace

The upper end of the interventricular septum is identified by the 'POINT OF OPPOSITE PULSATION' between the left ventricle and the pulmonary artery. The dome of the left side of the diaphragm usually obscures the lower border of the heart and the lower end of the interventricular septum

All four intracardiac valves have been represented schematically on the anterior surface of the heart. The frontal projection of the left ventricle, left atrium and aorta have been emphasized in this drawing to illustrate the relative positions of the aortic and mitral valves. The AORTIC and PULMONIC VALVES are indicated by dotted lines, the MITRAL VALVE by 2 slanting bars, the TRICUSPID VALVE by 3 vertical bars

Not only may alterations in the total configuration of the heart be identified, e.g. as in pericardial effusion, but also abnormal pulsations of individual chambers or vessels may be visualized. Thus enlargement of the pulmonary artery, an aortic or left ventricular aneurysm and hilar ducts are some of the conditions that may be identified in the PA position. Enlargement of the RIGHT VENTRICLE is difficult to detect in this position since this chamber does not normally appear at either of the cardiac borders

Displacement and deformity of adjacent structures—spine, trachea or barium-filled esophagus—may be of diagnostic aid

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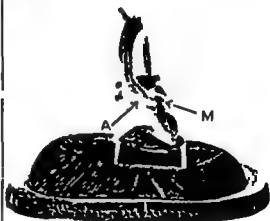
A



B



C



D

POSTERO-ANTERIOR (PA) VIEW continued

FIGURE 2—AT LEFT

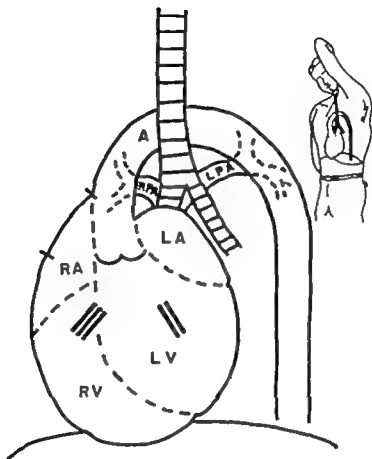
A. Model, normal heart asthenic subject

B. Normal male A vertical heart in a thin subject with low diaphragms

C. Model normal heart, short obese subject

D. Model plastic cast of interior of left ventricle left atrium and aorta illustrating the relative positions of the mitral valve (M) and aortic valve (A)

NOTES



THE LEFT ANTERIOR OBLIQUE (LAO) VIEW

FIGURE 3—AT LEFT

This position makes available anatomic information not readily gained in any other position. Enlargement of the LEFT VENTRICLE is established by measurement of the contour bounded by the atrioventricular and interventricular grooves. An enlarged LEFT ATRIUM may displace the left main bronchus superiorly and encroach upon the AORTIC WINDOW. A calcification of the aorta may be visible. The size of the RIGHT AURICULAR APPENDAGE is best judged in this view.

The positions of the MITRAL, AORTIC and TRICUSPID VALVES are indicated.

The anterior outline of the heart is formed from below upward by the RIGHT VENTRICLE, the RIGHT AURICULAR APPENDAGE and the ASCENDING AORTA. The course of the AORTA is well seen in this view. The posterior outline of the heart is formed by the LEFT VENTRICLE below and the LEFT ATRIUM above. A shallow groove, the ATRIOVENTRICULAR GROOVE, separates the two. At the junction of the left ventricle with the diaphragm the INTERVENTRICULAR GROOVE can often be demonstrated following deep inspiration. The border between the two grooves delineates the contour of the LEFT VENTRICLE.

The bifurcation of the TRACHEA lies within the shadow of the AORTIC ARCH.

Continued on next page

NOTES



A



B



C



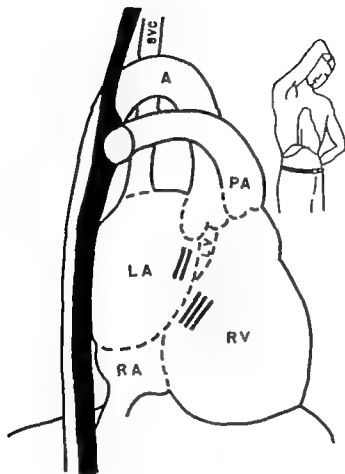
D

LEFT ANTERIOR OBLIQUE (LAO) VIEW continued

FIGURE 4—AT LEFT

- A. Model normal heart asthenic subject
- B Normal male Extra-cardiac calcifications are superimposed upon the cardiac silhouette
- C Model left ventricular enlargement due to systemic hypertension
- D Patient with systemic hypertension left ventricular enlargement

NOTES



THE RIGHT ANTERIOR OBLIQUE (RAO) VIEW

FIGURE 5--AT LEFT

This view has particular value in detecting enlargements of the RIGHT VENTRICLE anteriorly and LEFT ATRIUM posteriorly. Examination for the LEFT ATRIUM in this position includes observation of indentation of the barium filled esophagus after establishing in the PA view that the esophagus is pursuing its normal course in the thorax.

The abnormal course of certain vascular structures may be identified by distortion of the barium filled esophagus.

In the normal heart the anterior (retro-sternal) border is formed by the anterior border of the RIGHT VENTRICLE. The posterior contour of the heart is formed by the LEFT ATRIUM above and the RIGHT ATRIUM and INFERIOR VENA CAVA below. The ESOPHAGUS usually lies between the anterior border of the aorta (behind) and the posterior border of the heart. When filled with thick barium the continuity of its anterior contour is broken by normal indentations of the aorta, the right bronchus and the contraction of the diaphragm.

The relative positions of all four of the heart valves are indicated in the drawing at the left.

Continued on next page

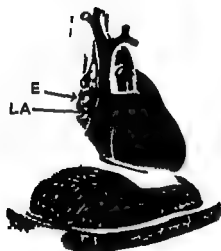
NOTES



A



B



C



D

RIGHT ANTERIOR OBLIQUE (RAO) VIEW : continued

FIGURE 6—AT LEFT

A. Model normal heart, asthenic subject. Esophagus (E) left atrium (LA) and right atrium (RA) are indicated to emphasize their relations in this position

B Normal male

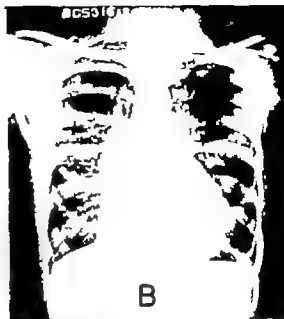
C Model demonstrating displacement of the esophagus (E) posteriorly and to the right by an enlarged left atrium due to mitral stenosis. The right atrium lies anterior and inferior to the left atrium

D Patient with mitral stenosis, illustrating displacement of the barium filled esophagus by the large left atrium

NOTES



A



B



C

RIGHT VENTRICULAR HYPERTROPHY CHRONIC COR PULMONALE

(PA View)

FIGURE 7—AT LEFT

A Model demonstrating prominent pulmonary artery segment and right ventricular hypertrophy

B Patient with chronic cor pulmonale secondary to chronic obstructive pulmonary emphysema right ventricular enlargement severe pulmonary hypertension congestive heart failure normal sinus rhythm Class IV E

C Same patient as B after intensive treatment for congestive heart failure with bed rest salt restriction antibiotics bronchodilators digitalis and mercurial diuretics chronic cor pulmonale secondary to chronic obstructive emphysema right ventricular enlargement now only minimal pulmonary hypertension normal sinus rhythm Class II C

NOTES



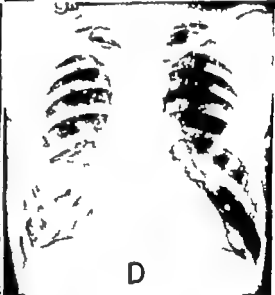
A



B



C



D

LEFT VENTRICULAR HYPERTROPHY (PA View)

FIGURE 8—AT LEFT

A. Model demonstrating enlargement of the left ventricle and dilatation of the ascending aorta (AO)

B Patient illustrating left ventricular enlargement due to hypertensive cardiovascular disease

C Patient illustrating left ventricular enlargement and dilatation of the ascending aorta due to arteriosclerotic heart disease

D Patient, illustrating left ventricular enlargement due to aortic insufficiency

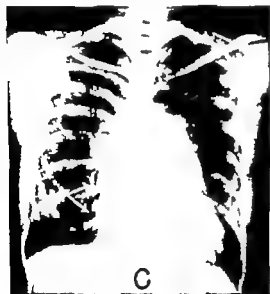
NOTES



A



B



C



D

MITRAL STENOSIS (PA View)

FIGURE 9—AT LEFT

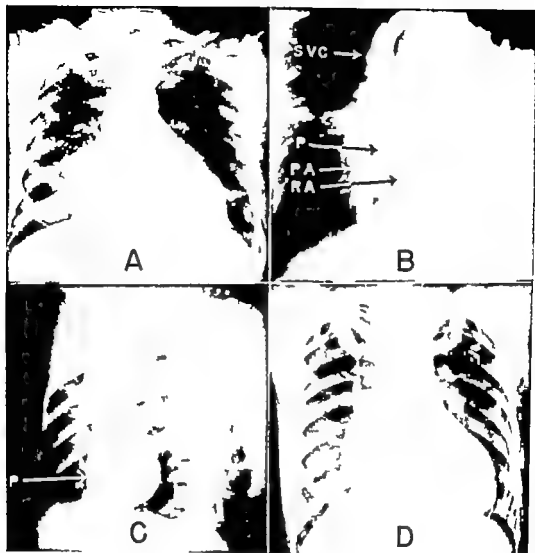
A Model demonstrating enlargement of the left atrium (LA) and of the right ventricle in mitral stenosis

B Patient with mitral stenosis The normal concavity in the region of the pulmonary artery is obliterated by the prominent pulmonary artery and the dilated left auricular appendage Intrapulmonary vascular markings are prominent

C Patient with mitral stenosis Illustrating the double contour on the right border of the heart due to the left and right atria (double arrows) A similar double contour is seen in models in A and D

D Model of mitral stenosis and aortic insufficiency with combined enlargement of the left atrium (LA) right ventricle and left ventricle

NOTES



PERICARDITIS

FIGURE 10—AT LEFT

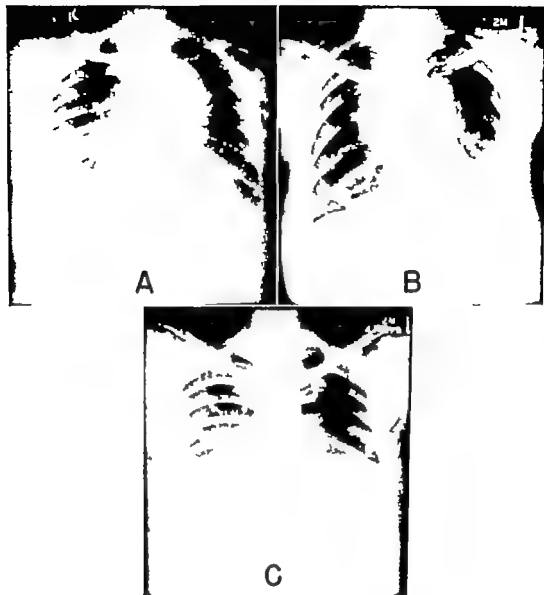
A. Pericarditis with effusion PA view

B Pericarditis with effusion PA angiogram During this exposure dye renders the superior vena cava right atrium (RA) and pulmonary artery (PA) opaque The area between RA and PA is less radiolucent than normal due to the presence of a pericardial sac distended with fluid

C Constrictive pericarditis LAO view with the calcified pericardium (P) demarcating the cardiac chambers

D Generalized cardiac enlargement due to diffuse myocardial disease The cardio-hepatic angles are sharper than in A but distinction from pericarditis with effusion may be difficult in such cases.

NOTES

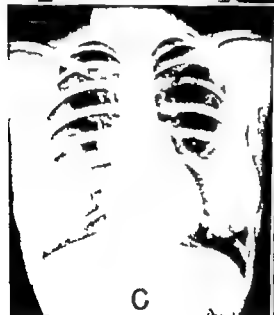
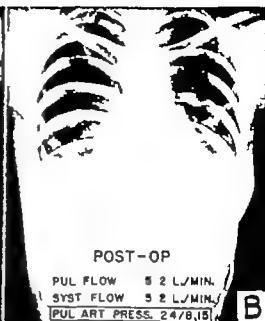
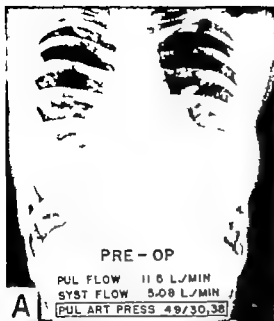


ANEURYSMS (PA View)

FIGURE 11—AT LEFT

- A. Aneurysm of aortic arch
- B Aneurysm of ascending aorta, with flecks of calcium in aneurysmal sac
- C Aneurysm of left ventricle following myocardial infarction Lung fields are congested

NOTES



ACYANOTIC CONGENITAL HEART DISEASE (PA View)

FIGURE 12—AT LEFT

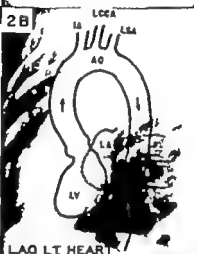
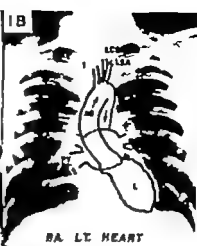
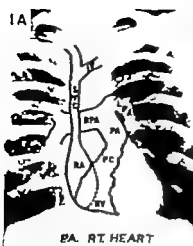
A. Patent ductus arteriosus prior to surgery. Pulmonary arterial pressures and flows are indicated.

B. Same patient as A. after ligation of ductus. The prominence of the pulmonary arterial segment and pulmonary congestion have decreased.

C. Inter atrial septal defect of small size. Pulmonary arterial segment is prominent.

D. Inter atrial septal defect of large size. The transverse diameter of the heart is increased. The pulmonary artery segment is very prominent. pulmonary vascular markings are increased.

NOTES



ANGIOCARDIOGRAPHY

FIGURE 12—AT 1977

Idealized diagrams of configuration

1A FRONTAL PROJECTION RIGHT HEART

IV Left innominate vein SVC Superior vena cava RA, Right atrium RV Right ventricle PC Pulmonary conus PA, Pulmonary artery LPA, Left pulmonary artery RPA, Right pulmonary artery

1B FRONTAL PROJECTION LEFT HEART

IA Innominate artery LCCA, Left common carotid artery LSA, Left subclavian artery PA Pulmonary vein LA Left atrium LV Left ventricle AO Aorta

2A LEFT ANTERIOR OBLIQUE PROJECTION RIGHT HEART

SVC Superior vena cava IVC Inferior vena cava RA, Right atrium RV Right ventricle RAA, Right auricular appendage PA, Pulmonary artery RPA, Right pulmonary artery LPA, Left pulmonary artery IAS Interatrial septum IVS Interventricular septum

2B LEFT ANTERIOR OBLIQUE PROJECTION LEFT HEART

IA Innominate artery LCCA Left common carotid artery LSA Left subclavian artery LA Left atrium LV Left ventricle AO Aorta

3A RIGHT ANTERIOR OBLIQUE PROJECTION RIGHT HEART

SVC Superior vena cava RA, Right atrium RV Right ventricle PC Pulmonary conus PA, Pulmonary artery RPA, Right pulmonary artery The left pulmonary artery is seen as a rounded, double-density nodular shadow

3B RIGHT ANTERIOR OBLIQUE PROJECTION LEFT HEART

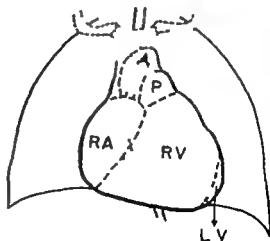
LA Left atrium LV Left ventricle AO Aorta In this projection, the left atrium and the right atrium form the posterior cardiac border

NORMAL INFANT AND CHILD

FIGURE 14



In the normal infant and child, the chest is rounder the diaphragm higher and the chest squatter than in the normal adult.



Electrocardiography

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Normal Sinus Rhythm, Vertical Position	36
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I



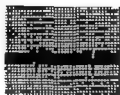
II



III



aVR



aVL



aVF



V1



V2



V3



V4



V5



V6

Normal Electrocardiogram—vertical position

NORMAL SINUS RHYTHM—VERTICAL POSITION

REPORT OF ELECTROCARDIOGRAM

EKG No. 1

Name _____ Age 22 Dat & Time _____ Chart \ _____

Blood Pressure 120/70 Habitus Asthenic Position Supine Drugs None

Atrial rate 88 /min P R interval 0.17 sec Q T interval _____ sec.
 Vent rate 88 /min QRS duration 0.0 sec Dev Elect Axis None

Deviation from Normal	{	I _____	V1 _____
		II _____	V2 _____
		III _____	V3 _____
		VR _____	V4 _____
		VL _____	V5 _____
		VF _____	V6 _____

Interpretation Normal sin rhythm \ axis deviation

Normal record Vertical electrocardiographic position

The ventricular complexes of lead VL are similar to those of leads V1 and V2 the ventricular complexes of lead VF are similar to those of lead V5 and V6



I



II



III



aVR



aVL



aVF



V1



V2



V3



V4



V5



V6

Normal Electrocardiogram—horizontal position

NORMAL SINUS RHYTHM—HORIZONTAL POSITION

REPORT OF ELECTROCARDIOGRAM

Name _____ Age 45 Date & Time _____ FKG \

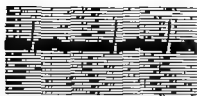
Blood Pressure 140/70 Habit Smoker Position 9 pm Drugs _____ Chart \

Atrial rate 78 min.
 Vent. rate 8 min.
 P-R interval 0.1 sec
 QRS duration 0.07 sec
 Q-T interval 1 sec
 Dev. Elect. axis _____ Left sec

Derivation from Normal	I	—	VI	—	—
	II	—	—	—	—
	III	—	—	—	—
	aVR	—	—	—	—
	aVL	—	—	—	—
	aVF	—	—	—	—

Interpretation Normal sinus rhythm Left in derivation
 Normal record Horizontal electrocardiographic position

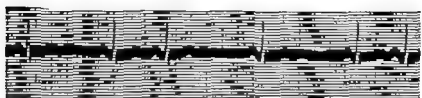
The entricular complexes of lead VL resemble those of lead VS and VF the entricular complexes of lead VF are similar to those of leads VI and V2



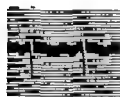
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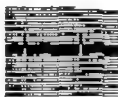
III



II



aVR



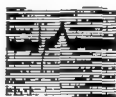
aVL



aVF



V1



V3



V5

Sinus Arrhythmia

SINUS ARRHYTHMIA

REPORT OF ELECTROCARDIOGRAM

Name _____ Age 21 Date & Time _____ PKG \ 1
 Blood Pressure 110/65 Habitus _____ Chart \ _____
 Position Supine Drugs _____

Atrial rate 73 /min.
 Vent. rate 76 /min

P R interval 0.18 sec
 QRS duration 0.05 sec
 Q-T interval _____ sec
 Dev. Elect. Axis _____

Deviation
from
Normal

I	_____	_____
II	_____	_____
III	_____	_____
aVR	_____	_____
VL	_____	_____
VF	_____	_____

Interpretation Si no arrhythmia \ axis deviation

Pattern marked as no arrhythmia is noted but the form of the complexes is otherwise
unremarkable



I



II



III



aVR



aVL



aVF



V1



V3



V5

Atrial Premature Contractions

ATRIAL PREMATURE CONTRACTIONS

REPORT OF ELECTROCARDIOGRAM

EKG No. 4

Name _____ Age 30 Sex Male Date & Time _____ Chart No. _____

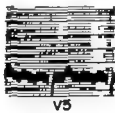
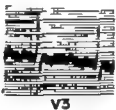
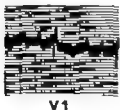
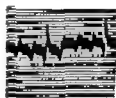
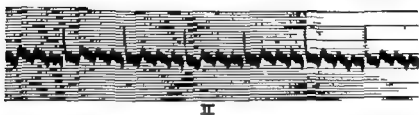
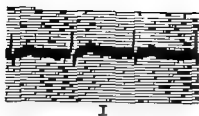
Blood Pressure 180/78 Habitus _____ Position Supine Drugs _____

Atrial rate 5 /min P R interval 0.17 sec Q-T interval _____ sec
 Vent. rat 75 /min. QRS duration 0.07 sec Dev. Elect Axis Left

Deviation from Normal	{	I _____	V1 _____
		II _____	V2 _____
		III _____	V3 _____
		VR _____	V4 _____
		VF _____	V5 _____
		VL _____	V6 _____

Interpretation Normal sinus rhythm atrial premature contractions Left axis deviation

A moderate number of premature atrial beats are noted and are marked with dots. The form of the complexes is otherwise unremarkable.



Atrial Flutter

ATRIAL FLUTTER

REPORT OF ELECTROCARDIOGRAM

ENC \ 3

Name Age 30 Sex Date & Time Chart \

Blood Pressure 100/70 Habitus Position 9 pm Drugs none

Atrial rate 288 /min P R interval sec Q T interval sec
 Vent rate 2 /min QRS duration 0.09 sec Dev. Elect Axis none

Deviation from Normal	{	I <u> </u>	V1 <u> R' present </u>
		II <u> </u>	V2 <u> </u>
		III <u> R altered </u>	V3 <u> </u>
		VR <u> </u>	V4 <u> </u>
		VL <u> </u>	V5 <u> </u>
		VF <u> </u>	V6 <u> </u>

Interpretation Atrial flutter with 4:1 A V response \ axis deviation

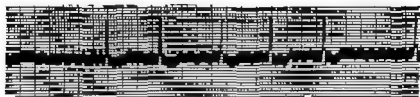
 In addition to the arrhythmia, the presence of an R' in V1 suggests anomalous right bundle branch block. T waves are obscured.



I



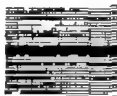
III



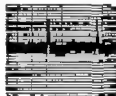
II



aVR



aVL



aVF



V1



V3



V5

Atrial Fibrillation

ATRIAL FIBRILLATION

REPORT OF ELECTROCARDIOGRAM

EKG N 6

Name _____ Age 60 Dat & Time _____ Chart N _____

Blood Pressure 160/90 Habitus _____ Position Supine Drugs None

Atrial rate 450 /min P R interval _____ sec Q-T interval _____ sec

Vent. rate 70 /min QRS duration 0.05 sec Dev. Elect. Axis None

Deviation
from
Normal

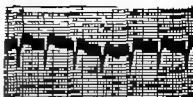
I <u>T low</u>	V1 _____
II <u>ST depressed</u>	V2 _____
III <u>T low</u>	V3 <u>T displaced</u>
VR <u>T upright</u>	V4 _____
VL <u>T low</u>	V5 <u>T inverted</u>
VP <u>ST depressed, T low</u>	V6 _____

Interpretation Atrial fibrillation & no deviation

The T waves, although obscure at times, suggest the presence of myocardial disease



I



III



II



aVR



aVL



aVF



V1



V3



V5

Supraventricular Tachycardia

SUPRAVENTRICULAR TACHYCARDIA

REPORT OF ELECTROCARDIOGRAM

Name _____ Age 30 Sex Male Date & Time _____ EKG No. _____
 Blood Pressure 125/80 Habits _____ Position Supine Chart No. _____
 Atrial rate _____ /min. P-R interval _____ sec. Q-T interval _____ sec.
 Vent. rate 138 /min. QRS duration 0.09 sec. Des. Elect. Axis _____ Left _____
 Deviation from Normal {
 I ST depressed _____ V1 _____
 II ST depressed _____ V2 _____
 III _____ V3 ST depressed _____
 VR ST elevated _____ V4 _____
 aVL ST depressed _____ V5 ST depressed _____
 VF _____ V6 _____
 Interpretation Supraventricular tachycardia Left axis deviation
Definite atrial ectopic can be seen



I



III



II



aVR



aVL



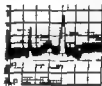
aVF



V1



V3



V5

Ventricular Premature Contractions—coupled with compensatory pause

VENTRICULAR PREMATURE CONTRACTIONS

REPORT OF ELECTROCARDIOGRAM

EKG \ 8

Name _____ Age 46 Date & Time _____ Chart \ _____

Blood Pressure 130/70 Habits _____ Position 8 pos Drugs None

Atrial rate 85 /min. P R interval 0.13 sec Q-T interval _____ sec
Ventr rate 82 /min. QRS duration 0.03 sec Dev Elect A _____ sec

Deviation
from
Normal

I _____	V1 _____
II _____	V2 _____
III _____	V3 _____
VR _____	V4 _____
VL _____	V5 _____
V7 _____	V6 _____

Interpretation Normal sinus rhythm with couplet premature ventricular contractions 1 sec deviation

The form of the in no leads is within normal limits



I



II



III



CF4

Ventricular Tachycardia

VENTRICULAR TACHYCARDIA

REPORT OF ELECTROCARDIOGRAM

EKG \ 9

Name _____ Age 65 Date & Time _____ Chart \ _____

Blood Pressure 85/60 Habitus _____ Position Supine Drugs None

Atrial rate _____ /min. P R interval _____ sec. QT interval _____ sec.

Vent. rat 187 /min. QRS duration 0.13 sec. Dev. Elect. Axis _____

Deviation
from
Normal

I	V1
II	V2
III	V3
VB	V4
VL	V5
aVF	V6

Interpretation. Ventricular tachycardia.

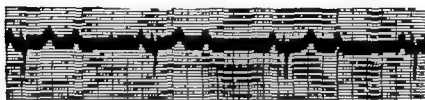
A rapid regular tachycardia is noted. 4 widened QRS which greater than 0.12 second in duration suggests preexcitation arising somewhere in the ventricle, or that bundle branch block is present. Comparison with previous records clearly demonstrates that bundle branch block is not present here. Furthermore careful analysis of this record indicates that the P waves are completely dissociated in their rhythm from the QRS complex, confirming the presence of ventricular tachycardia.



I



III



II



aVR



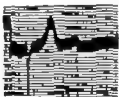
aVL



aVF



V1



V3



V5

2 1 A V Block

ATRIOVENTRICULAR BLOCK (2 1)

REPORT OF ELECTROCARDIOGRAM

EKG N 10

Name _____ Age 2 Dat & Time _____ Chart N _____

Blood Pressure 160/70 Habitus _____ Location R par Drugs None

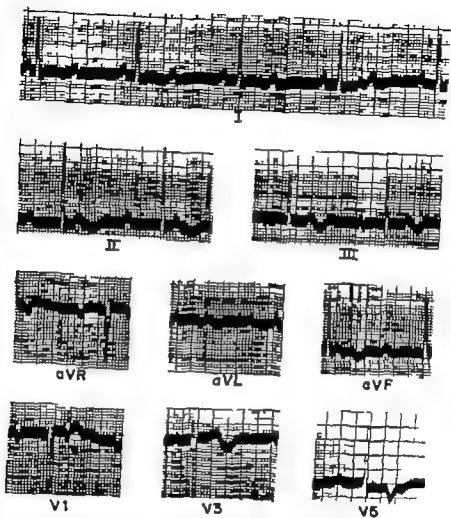
Atrial rate 70 /min P R interval 0.20 sec Q-T interval _____ sec.

Vent. rate 35 /min QRS duration 0.04 sec De Elect Axis Left

Deviation from Normal	{	I _____	V1 <u>R present</u>
		II _____	V2 _____
		III _____	V3 _____
		VR <u>R present</u>	V4 _____
		VL _____	V5 _____
		VP _____	V6 _____

Interpretation Normal sinus rhythm with 2 1 1 block. Left is deviation

Every other atrial beat is followed by ventricular response. The presence of R in 1 1 suggests complete right bundle branch block.



Complete A V Block with His Bundle Rhythm

ATRIOVENTRICULAR BLOCK, COMPLETE, WITH HIS BUNDLE RHYTHM

REPORT OF ELECTROCARDIOGRAM

EKG No 11

Name _____ Age 55 Date & Time _____ Chart \ _____

Blood Pressure 130/40 Habitus _____ Position Supine Drugs None

Atrial rate 88 /min. P R interval _____ sec Q-T interval _____ sec

Vent. rate 45 /min. QRS duration 0.07 sec Dev Elect Axis None

Deviation
from
Normal

I T inverted V1 _____

II T inverted V2 _____

III T inverted V3 _____

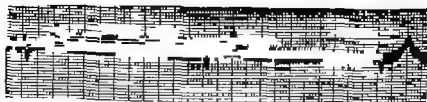
VR T upright V4 _____

VL _____ V5 T inverted

VP _____ V6 _____

Interpretation Normal sinus rhythm with complete A V block and idiosyncratic His bundle rhythm
& axis deviation.

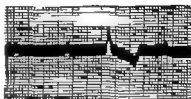
The atrial beats bear no relation to an ectopic pacemaker arising somewhere on the
His bundle just below the A V node.



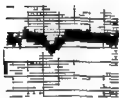
I



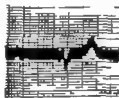
II



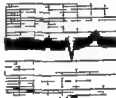
III



aVR



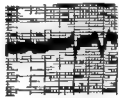
aVL



aVF



V1



V3



V5

Complete A V Block with Idioventricular Rhythm

ATRIOVENTRICULAR BLOCK COMPLETE WITH IDIOVENTRICULAR RHYTHM

REPORT OF ELECTROCARDIOGRAM

EKG N 12

Name _____ Age 42 Date & Time _____ Chart N _____

Blood Pressure 110/70 Habit _____ Duration 5 min Drugs None

Atrial rate 80/min P R interval 11 sec Q T interval 11 sec
 Vent. rate 83/min QRS duration 11 sec Dev. Elect Axis _____

Deviation from Normal	I	_____	V1	_____
	II	_____	V2	_____
	III	_____	V3	_____
	aVR	_____	V4	_____
	aVL	_____	V5	_____
	VF	_____	V6	_____

Interpretation Normal sinus rhythm with complete A-V block and idioventricular rhythm

The atria are beating at a slower rate than, and are wholly independent of, main sinus automatic pacemaker arising from the ventricles superior area.



I



II



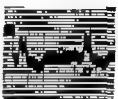
III



aVR



aVL



aVF



V1



V2



V3



V4



V5



V6

Left Bundle Branch Block

LEFT BUNDLE BRANCH BLOCK

REPORT OF ELECTROCARDIOGRAM

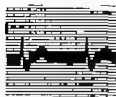
EKG N 13Name _____ Age 35 Sex Male Chart No. _____Blood Pressure 180/70 Habitu _____ Position S prone Drugs NoneAtrial rate 78 /min. P-R interval 0.1 sec Q-T interval _____ sec.Vent. rate 72 /min. QRS duration 0.16 sec Dev. Ekt. Axis NoneDeviation
from
Normal

{	I	<u>R slurred, ST depressed, T diphase</u>	<u>V1</u>	<u>R slurred</u>
	II	<u>R slurred, ST depressed, T diphase</u>	<u>V2</u>	
	III	<u>R slurred, T inverted</u>	<u>V3</u>	
	VR	<u>ST elevated, T upright</u>	<u>V4</u>	
	VL		<u>V5</u>	<u>R' present, ST depressed, T diphase</u>
	aVF	<u>R slurred, ST depressed, T inverted</u>	<u>V6</u>	<u>R' present, ST depressed, T inverted</u>

Interpretation Normal as to rhythm, no axis deviation, left bundle branch block

The delayed R' over the left ventricle (the onset of the intrinsoid deflection equals 0.13 second) confirms left bundle branch block. Abnormalities of ST and T waves are usually seen. Left bundle branch block.

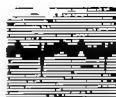
The "intrinsoid deflection" determined in the precordial lead measures the time it takes for stimulus to reach point directly beneath the precordial electrode. In this instance the time from onset of Q-T the peak of R



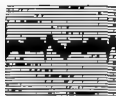
I



II



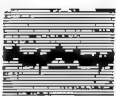
III



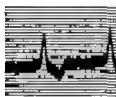
aVR



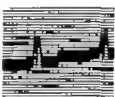
aVL



aVF



V1



V2



V3



V4



V5



V6

Right Bundle Branch Block and Long P R Interval

RIGHT BUNDLE BRANCH BLOCK. INCOMPLETE AVRTICULAR BLOCK

REPORT OF ELECTROCARDIOGRAM

EKG N 11

Name Age 31 Sex M Chart N

Blood Pressure 103/70 Height in lbs Drugs None

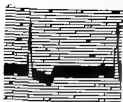
Atrial rate 78 /min. P-R interval 0.29 sec Q-T interval sec
Vent. rate 73 /min. QRS duration 0.15 sec Der. Elect. Axis Left

Deviation
from
Normal

I	S wide	V1	R' present
II		V2	R' present
III		V3	
VB		V4	S wide
VL	T low	V5	S wide
VF		V6	S wide

Interpretation Normal sinus rhythm. Left axis deviation. Incomplete 1° block (prolonged P-R interval). Right bundle branch block.

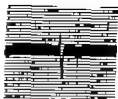
The delayed R' over the right ventricle (the onset of the intraventricular deflection equals 0.04 second) confirms right bundle branch block.



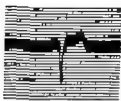
I



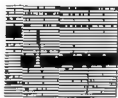
II



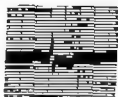
III



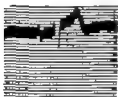
aVR



aVL



aVF



V1



V2



V3



V4



V5



V6

Left Ventricular Hypertrophy

LEFT VENTRICULAR HYPERTROPY

REPORT ON

1

HC No. 13

Name Age

Chart No.

Blood Pressure 220/110 Habitus

Drugs None

Atrial rate 80 /min. P R term 0.40 sec Q T interval sec
Vent rat 60 /min QRS duration 0 sec Dev Elect axi Left

Deviation
from
Normal

I <u>ST depressed, T inverted</u>	V1 <u>S deep, ST elevated</u>
II <u>BT depressed, T inverted</u>	V2 <u> </u>
III <u>T inverted</u>	V3 <u>ST depressed T inverted</u>
VR <u>T upright</u>	V4 <u>ST depressed, T inverted</u>
VL <u>T diphasic</u>	V5 <u>R delayed</u>
VF <u>T is axial</u>	V6 <u>R delayed</u>

Interpretation Normal in rhythm Left axis deviation

The left ventricular activation is delayed (the onset of the transmural deflection equals 0.05 second) and with normal QRS interval suggests backward left ventricular myocardium. Deviation of ST and T waves are often seen the presence of this hypertrophy



I



II



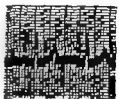
III



aVR



aVL



aVF



V1



V2



V3



V4



V5



V6

Right Ventricular Hypertrophy

RIGHT VENTRICULAR HYPERTROPHY

REPORT OF ELECTROCARDIOGRAM

EKG N 18

Name _____ Age 30 Date & Time _____ Chart No. _____

Blood Pressure 100/70 Habitus _____ P 1 hypert Drugs None

Atrial rate 88/min. P-R interval 0.1 sec Q-T interval _____ sec
Vent. rate 88/min. QRS duration 0.09 sec Dev. Elect. Axis Left Right

Deviation
from
Normal

I	<u>S deep</u>	VI	<u>R late and large</u>
II	_____	V2	<u>ST depressed, T inverted</u>
III	_____	V3	<u>ST depressed T inverted</u>
VR	_____	V4	<u>ST depressed, T depressed</u>
VL	_____	V5	<u>R deep, T inverted</u>
VP	_____	V6	<u>R deep</u>

Interpretation Normal sinus rhythm R-lead axis deviation

The late R wave over the left leads (the onset of the S wave deflection equal 0.06 second), presence of large R over the left leads, and the ST and T wave changes are characteristic of right ventricular hypertrophy

In this instance the time from onset of Q to the peak of R in precardial lead.



I



II



III



aVR



aVL



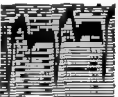
aVF



V1



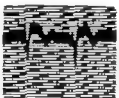
V2



V3



V4



V5



V6

Recent Anterior Myocardial Infarction

RECENT ANTERIOR MYOCARDIAL INFARCTION

REPORT OF EKG FROM VITAMIN RAM

EKG N 17

Name _____ Age 60 Date & Time _____ Chart No. _____

Blood Pressure 90/60 Habitus _____ Position < sup Drugs _____

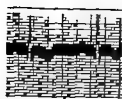
Atrial rate 88/min P R interval 0.20 sec Q T interval _____ sec

Vent. rate 80/min QRS duration 0.08 sec Dev. Elect. Axis Left

Deviation from Normal	I	T inverted	V1	Abnormal R, ST elevated
	II	ST depressed	V2	Abnormal R, ST elevated, T diphase
	III	ST depressed	V3	Abnormal R, ST elevated, T diphase
	VR		V4	R low, ST elevated, T inverted
	VL	ST elevated, T inverted	V5	R low, ST elevated, T inverted
	VF	ST depressed	V6	R low, T diphase

Interpretation: Normal sinus rhythm. Left axis deviation.

The low or abnormal R waves in I leads, together with the other reciprocal ST and T wave changes, are characteristic of recent anterior wall infarction.



I



II



III



aVR



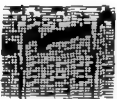
aVL



aVF



V1



V2



V3



V4



V5



V6

Old Anterior Myocardial Infarction

OLD ANTERIOR MYOCARDIAL INFARCTION

REPORT OF ECG BY J. J. RAM

ECG N 18

Name _____ Age 60 Date & Time _____ Chart N _____

Blood Pressure 110/60 Habitus _____ Posture S rest Drugs Digitalis 0.1 mg d

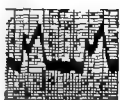
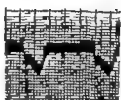
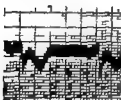
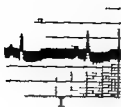
Atrial rate 88 /min. P R interval 0.23 sec QT interval _____ sec.
Vent. rate 84 /min. QRS duration 0.09 sec Dev Ect. None Left _____

Deviation
from
Normal

I <u>T inverted</u>	VI <u>Abundant R</u>
II _____	V2 <u>Abundant R T diaphase</u>
III <u>S deep</u>	V3 <u>R low T di phase</u>
VR <u>T low</u>	V4 <u>Abundant R, T inverted</u>
aVL <u>T inverted</u>	V5 <u>R low T inverted</u>
aVF _____	V6 <u>T inverted</u>

Interpretation Normal sinus rhythm. Left axis deviation. Incomplete 41 block (prolonged PR interval)

When compared with the patient's previous tracing (page 88), changes are seen suggesting evolution of the anterior wall infarct. Deviation in ST segments has resolved and the T waves have become more inverted and have increased in amplitude. The prolonged PR interval may be the result of digitalis administration.



aVR

aVL

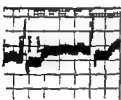
aVF



V1

V2

V3



V4

V5

V6

Recent Posterior Myocardial Infarction

RECENT POSTERIOR MYOCARDIAL INFARCTION

REPORT OF ELECTROCARDIOGRAM

EKG No. 19

Name _____ Age 46 Date & Time _____ Chart No. _____

Blood Pressure 100/80 Habitus _____ Position Supine Drugs None

Atrial rate 78 /min. P-R interval 0.16 sec Q-T interval _____ sec

Vent. rate 72 /min. QRS duration 0.08 sec Der. Elect. Axis None

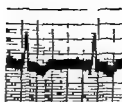
Deviation from Normal	I	T low	V1	ST depressed
	II	ST elevated	V2	ST depressed
	III	ST elevated	V3	ST depressed
	VR	ST depressed	V4	ST depressed
	VL	ST depressed	V5	
	VP	ST elevated	V6	

Interpretation Normal sinus rhythm. No axis deviation

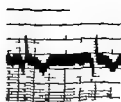
The elevated ST segments in leads II, III and AVF and reciprocal ST depressions in other leads are characteristic of recent posterior wall infarct.



I



II



III



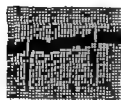
aVR



aVL



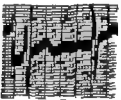
aVF



V1



V2



V3



V4



V5



V6

Old Posterior Myocardial Infarction

OLD POSTERIOR MYOCARDIAL INFARCTION

REPORT OF ELECTROCARDIOGRAM

EKG No. 20

Name _____ Age 45 Date & Time _____ Chart No. _____

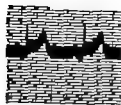
Blood Pressure 120/70 Habit _____ Position Supine Drugs None

Atrial rate 85 /min P-R interval 0.81 sec Q-T interval _____ sec
Ventricular rate 85 /min QRS duration 0.08 sec Dev. Elect. Axis None

Deviation from Normal	{	I _____	V1 _____
		II <u>T inverted</u>	V2 _____
		III <u>Q wide T inverted</u>	V3 _____
		VR <u>T upright</u>	V4 <u>T low</u>
		VL _____	V5 <u>T inverted</u>
		VF <u>Q wide, T inverted</u>	V6 <u>T inverted</u>

Interpretation Normal sinus rhythm, No axis deviation, Incomplete 41 block (prolonged P-R interval)

The wide Q waves in III and II F as well as T wave inversions are suggestive of posterior wall infarct, probably old, with some lateral wall damage as well



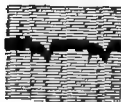
I



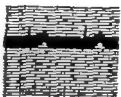
II



III



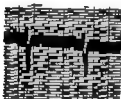
aVR



aVL



aVF



VI



V3



V5

Pericarditis—acute

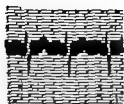
REPORT OF ELECTROCARDIOGRAM

EKG \ 21Name _____ Age 37 Sex _____ Date & Time _____ Chart \ _____Blood Pressure 180/70 Habitus _____ Position 9 pos Drugs NoneAtrial rate 78 /min. P R interval 0.14 sec. Q T interval _____ sec.Vent. rate 8 /min. QRS duration 0.06 sec. Dev. Elect. Axis NoneDeviation
from
Normal

I	ST elevated	V1
II	ST elevated	V2
III	ST elevated	V3
VR	ST depressed	V4
VL		V5
VF	ST elevated	V6

Interpretation Normal sinus rhythm \ axis deviation

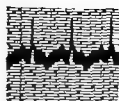
The elevated ST segments in all three standard leads without QRS changes, are con-
sistent with acute pericarditis



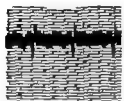
I



II



III



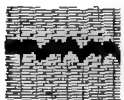
aVR



aVL



aVF



V1



V3



V5

Pulmonary Embolism

REPORT OF ELECTROCARDIOGRAM

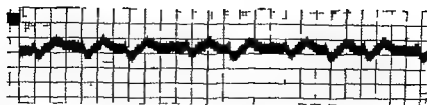
EKG N 82Name _____ Age 45 Date & Time _____ Chart N _____Blood Pressure 100/80 Habits _____ Position Supine Drugs None
 Heart rate 125 /min. P R interval 0.16 sec. Q T interval _____ sec.
 Vent. rate 125 /min. QRS duration 0.08 sec. Dev. Elect. Axis Right

 Deviation
 (from
 Normal)

I <u>B deep</u>	V1 <u>ST elevated</u>
II <u>T diphasic</u>	V2 _____
III <u>T inverted</u>	V3 <u>T inverted</u>
VR <u>R present</u>	V4 _____
VL _____	V5 _____
VF <u>T inverted</u>	V6 _____

 Interpretation Severe backwardness. Right axis deviation

Since previous tracing taken on this patient 8 hours ago there has been a significant increase in ventricular rate. In addition, right axis deviation such as a deep QRS in lead III and a deeply downward QRS in lead I has appeared. T₂ which was previously upright has become diphasic, and T₃ has become inverted as well as T₄. A R has appeared in lead aVR, and the ST segment in lead V₁ is slightly elevated. These changes are suggestive of acute right heart strain of the type often seen in recent pulmonary embolism. The diagnosis of this condition is dependent upon the demonstration of arterial changes of an embolic nature.



I



II



III



V1



V3



V5

Hyperkalemia—K, 8.6 mEq/L, Na 113 mEq/L

HYPERKALEMIA

REPORT OF ELECTROCARDIOGRAM

EKG No. 23

Name _____ Age 58 Date & Time _____ Chart No. _____

Blood Pressure 120/60 Habitus _____ Position S prone Drugs _____ None

Atrial rate _____ /min. P R interval _____ sec Q-T interval _____ sec

Vent. rate 80 /min. QRS duration 0.11 sec Der. Elect. Ax. _____

Deviation
from
Normal

I _____	VI _____
II _____	V2 _____
III _____	V3 _____
aVR _____	V4 _____
aVL _____	V5 _____
aVP _____	V6 _____

Interpretation Idioventricular rhythm

Since the previous record (not illustrated), the patient has developed marked widening of the QRS complex as well as complete ST depression & idioventricular pacemaker is seen. The rhythm is grossly irregular. The abnormalities are consistent with marked derangement of cardiac metabolism.

SECTION 3

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Events of the Cardiac Cycle	88
The Pressure Pulse in Congenital Heart Disease	90
Phonocardiography	93

HEMODYNAMIC AND PULMONARY FUNCTIONS

Representative NORMAL VALUES

Blood and Blood Gases

Arterial blood O₂ content = 16.5–20 ml / 100 ml of blood

Arterial or venous blood oxygen capacity = 17–21 ml / 100 ml of blood

Arterial blood O₂ saturation = $\frac{\text{O}_2 \text{ content}}{\text{O}_2 \text{ capacity}} \times 100 = 96\text{--}98\%$

Arterial blood CO₂ content (whole blood) = 40–55 ml / 100 ml =
18–25 mEq / liter

pH arterial plasma = 7.38–7.41

Arterial blood and alveolar CO₂ tension = P_aCO₂ = 38–41 mm Hg

Mixed venous blood O₂ content = 12–16 ml / 100 ml

CO combining power (venous blood) = 50–70 ml / 100 ml =
21–30 mEq / liter

Hematocrit = per cent red blood cells in blood = 38–48

Hemoglobin = 13–16 gm / 100 ml of blood

Blood oxygen capacity ml / 100 ml of blood $\times 0.740 =$
hemoglobin gm / 100 ml The factor 0.740 is derived from the fact
that 1 gm of hemoglobin combines with 1.34 ml of oxygen

(ml / 100 ml of blood = vol-% in older terminology)

Continued on next page

HEMODYNAMIC AND PULMONARY FUNCTIONS

NORMAL VALUES — continued

Cardiocirculatory

Blood Volume

Total blood volume average = 2500 cc /sq m B.S.A.*

Plasma volume average = 1500 cc /sq m B.S.A.

Red cell volume average = 1000 cc /sq m B.S.A.

Cardiac Output normal range = 4.0-6.5 lit /min

Cardiac Index normal range = 2.7-3.5 lit /min /sq m B.S.A.

Blood Pressures representative

	SYSTOLIC mm Hg	DIASTOLIC mm. Hg	MEAN mm Hg	MEAN cm. Hg()
Brachial vein	—	—	1	3.7
Right atrium	—	—	0	0.5
Right ventricle	22	0	—	
Pulmonary artery	22	8	13	
Left atrium	—	—	7	
Left ventricle	120	8	—	
Brachial artery	120	80	95	

BODY SURFACE AREA (B.S.A.) ACCORDING TO DU BOIS FORMULA

B.S.A. in square meters = (weight in kg.)^{0.725} × (height in cm.)^{0.725} × 0.007184

Sample values	HEIGHT		WEIGHT		B.S.A. square meters
	Ft.	cm.	lbs.	Kg.	
	4.10	124	90	41	1.23
	5.8	173	140	63	1.73
	6.2	188	210	95	2.20

HEMODYNAMIC AND PULMONARY FUNCTIONS

NORMAL VALUES continued

Pulmonary

Vital Capacity liters Male = $2.5 \times \text{sq m B.S.A.}$
 Female = $2.0 \times \text{sq m B.S.A.}$

Tidal Air liters 0.550 to 0.600

Residual Volume (air in lungs at maximal expiration) liters 1.0 to 1.5

Total Lung Capacity = Vital Capacity + Residual Volume liters 5.0 to 7.5

Residual Volume/Total Capacity = 20 to 30%

Maximum Breathing Capacity † Male = 100–150 lit/min
 Female = 70–120 lit/min

Respiratory Rate at rest 8–20/min

Pulmonary Ventilation at rest 2.5–4.0 lit/min sq m B.S.A.

Oxygen Uptake at rest 110–140 cc/min sq m B.S.A.

CO Output at rest 88–120 cc/min sq m B.S.A.

Respiratory Exchange Ratio (Resp Quotient RQ) 0.77–0.90

Bronchiopneumetry function in right lung 52–58 per cent left lung 48–42 per cent

Timed Vital Capacity first second 75% or more of total vital capacity
 first 2 seconds 90% or more first 3 seconds 100%

More accurate formulas

Males Vt l. exp., liters = $[27.63 - (0.112 \times \text{age in yr})] \times \text{Ht. in cm.}$

Females Vt l. exp. liters = $[21.78 - (0.101 \times \text{age in yr})] \times \text{Ht. in cm.}$

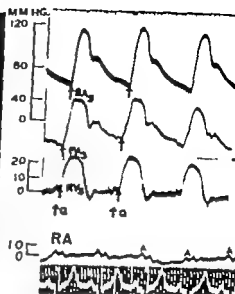
† Formulas

Males M B C lit./min. = $[80.5 - (0.222 \times \text{age in y})] \times \text{sq m B.S.A.}$

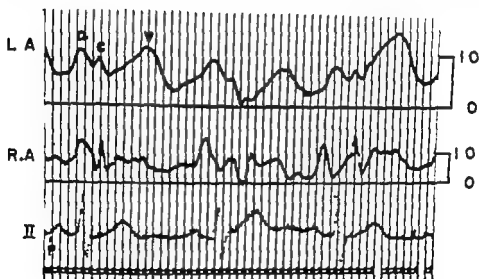
Females M B C lit./min. = $[71.5 - (0.474 \times \text{age in y})] \times \text{sq m B.S.A.}$



A



B



C

PRESSURE PULSES FROM THE HUMAN HEART

FIGURE 15—AT LEFT

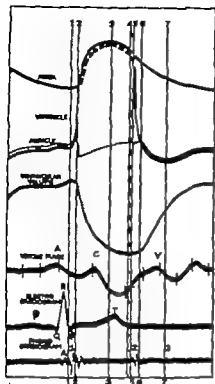
A. X Ray showing a cardiac catheter introduced via the right brachial vein into the right pulmonary artery

B. The relation between electrical and mechanical events on the right side of the heart. The electrical event is indicated by lead 2 of the electrocardiogram; the mechanical event is indicated by the pressure pulse in the right atrium, right ventricle, pulmonary artery, and brachial artery respectively. The pressures in the right atrium, ventricle, and pulmonary artery were recorded through a cardiac catheter.

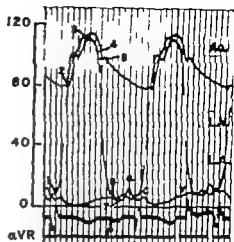
- P — Electrical event preceding atrial contraction
- A — Atrial systole
- Q — Electrical event preceding ventricular contraction
- RV — Start of isometric contraction of right ventricle
- PA₂ — Start of ejection of blood into pulmonary artery
- BA₂ — Start of ejection of blood into aorta as manifested in the brachial artery pressure pulse

C. Simultaneous pressure pulses in the right and left atria recorded by direct needle puncture during thoracic surgery. The configuration of the two curves is similar, differing primarily in the greater height of the V wave in the left atrial pressure pulse—a reflection of the lesser distensibility of the left atrial pulmonary venous system.

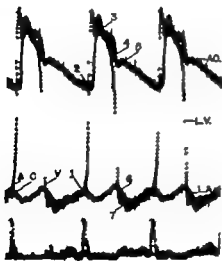
NOTES



A



B



C



D

EVENTS OF THE CARDIAC CYCLE

FIGURE 16—AT LEFT

A. Schema based on observations in man and dog

- 1 Closure of A V valves
- 2 Opening of aortic valve
- 1-2 Isometric contraction
- 2-3 Maximal ejection.
- 3-4 Reduced ejection
- 4-5 Protodiastole
- 5 Closure of aortic valve
- 5-6 Isometric relaxation
- 6 Opening of A V valves
- 6-7 Rapid filling of ventricle
- 7 to atrial systole Diastasis.

Time line on venous pulse at 0.10 second

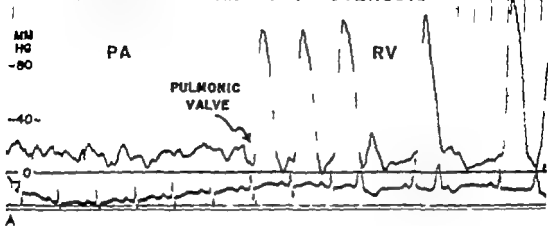
B Pressure pulses from the left side of the heart obtained during intra thoracic surgery by direct needling of the aorta (AO) left ventricle (LV) and left atrium (LA) in a subject without cardiovascular disease. Numbers 1-7 as above. Time between two vertical lines: 0.04 second.

C Pressure pulses in another normal subject without cardiovascular disease for comparison with (D)

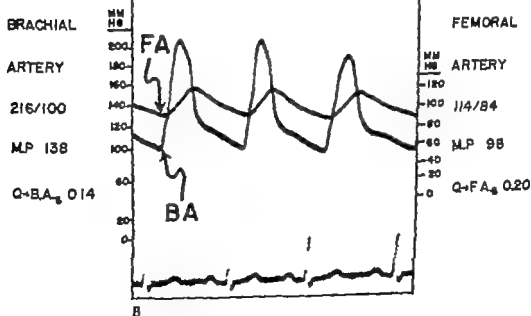
D Pressure pulses from the left side of the heart recorded prior to therapeutic fracture of the mitral valve in a patient with mitral stenosis. Symbols and numbers as above. Note in contrast to the normal pressure pulses, the pressure gradient between the left atrium and ventricle during diastole

NOTES

PULMONIC VALVULAR STENOSIS



COARCTATION OF AORTA



THE PRESSURE PULSE IN CONGENITAL HEART DISEASE

FIGURE 17—AT LEFT

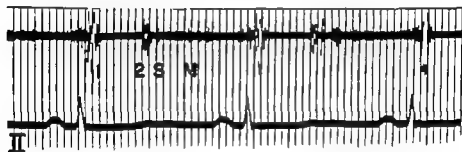
A. *Pulmonic valvular stenosis* A continuous tracing as the cardiac catheter is withdrawn from the pulmonary artery (I A) through the pulmonic valve into the right ventricle (RV) The pulmonary artery pressure is typically low and distorted by artefacts The right ventricular systolic pressure is considerably elevated The fourth ventricular beat is premature and clearly depicted in the electrocardiogram (lead 2)

B. *Coarctation of aorta* The brachial artery (BA) pressure is greater than normal The femoral artery pressure curve (FA) is deformed and has a lower systolic pressure than in the brachial artery

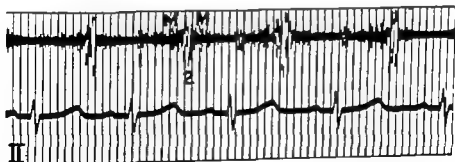
NOTES



A. NORMAL CHILD



B. MITRAL STENOSIS



C. PATENT DUCTUS ARTERIOSUS

PHONOCARDIOGRAPHY

FIGURE 18—AT LEFT

A *Normal child* illustrating first (1) second (2) and physiologic third (3) heart sounds

B *Pure' mitral stenosis* There is no systolic murmur (between 1 and 2) The opening snap of the mitral valve (S) is followed by a diastolic murmur with presystolic accentuation

C *Patent ductus arteriosus* The continuous machinery murmur (M) is illustrated in relation to the normal heart sounds (1 and 2)

NOTES

Nomenclature for Cardiac Diagnosis

SECTION 4

A complete diagnosis should include the following five considerations

- 1 *Etiology of the heart disease and whether active or inactive*
- 2 *Structural changes*
- 3 *Cardiac mechanism and disturbed cardiac physiology*
- 4 *Cardiac functional capacity*
- 5 *Therapeutic classification*

An example of a complete cardiac diagnosis is

- 1 Rheumatic heart disease inactive
- 2 Mitral stenosis and insufficiency tricuspid stenosis Enlarged heart (dilated left and right atria and right ventricle)
- 3 Atrial fibrillation persistent Congestive heart failure paroxysmal pulmonary edema
- 4 5 Class IHD

The descriptive material pertinent to the first three headings is too long for inclusion in this Notebook. It is detailed in the "Nomenclature and Criteria for Diagnosis of Diseases of the Heart" published by the New York Heart Association. Headings 4 and 5 cardiac functional capacity and therapeutic classification, are itemized on the next page.

CARDIAC FUNCTIONAL CAPACITY

- Class I** Patients with cardiac disease but *without resulting limitation of physical activity*. Ordinary physical activity does not cause undue fatigue, palpitation, dyspnea or anginal pain.
- Class II** Patients with cardiac disease resulting in *slight limitation of physical activity*. They are comfortable at rest. Ordinary physical activity results in fatigue, palpitation, dyspnea or anginal pain.
- Class III** Patients with cardiac disease resulting in *marked limitation of physical activity*. They are comfortable at rest. Less than ordinary physical activity causes fatigue, palpitation, dyspnea or anginal pain.
- Class IV** Patients with cardiac disease resulting in *inability to carry on any physical activity without discomfort*. Symptoms of cardiac insufficiency or of the anginal syndrome are present even at rest. If any physical activity is undertaken, discomfort is increased.

THERAPEUTIC CLASSIFICATION

- Class A** Patients with cardiac disease whose ordinary physical activity need not be restricted.
- Class B** Patients with cardiac disease whose ordinary physical activity need not be restricted but who should be advised against severe or competitive physical efforts.
- Class C** Patients with cardiac disease whose ordinary physical activity should be moderately restricted and whose more strenuous efforts should be discontinued.
- Class D** Patient with cardiac disease whose ordinary physical activity should be markedly restricted.
- Class F** Patient with cardiac disease who should be at complete bed rest, confined to bed or chair.

NO HEART DISEASE

- (a) Predisposing etiological factor e.g. rheumatic fever
- (b) Undiagnosed manifestation e.g. pulmonary valve murmur

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- intracardiac postero-anterior view 8-9

- right anterior oblique view 16-17

- mitral left anterior oblique view 18 13

- postero-anterior view 8-9 10-11

- pulmonary postero-anterior view 8-9

- truncal left anterior oblique view 12 13

- postero-anterior view 8-9

Ventilation, phonocardiogram normal, 84

Ventricle

- left aortic view of 23-29 enlarged

- left anterior oblique view 12 13

- 14-15 enlarged, in aortic stenosis, 21-23 enlarged, postero-anterior view 21-23

- postero-anterior view 8-9

- right enlarged, in cor pulmonale 28-21 enlarged, in aortic stenosis, 21-23 enlarged, postero-anterior view 8-9

- left anterior oblique view 12 13

- right anterior oblique view 16-17

Vital capacity normal, pulmonary 83

X-ray findings in abnormal hearts, 20-31 (see also Fluorography and -ray)

